CLAIMS

1. A method of determining the activity of an enzyme, or the effect a test compound has on the activity of the enzyme, by using mass spectrometry comprising:

i) providing a probe carrying an immobilised enzyme;

ii) optionally introducing the test compound;

iii) introducing one or more reactants to the immobilised enzyme for a time, and in a form sufficient for a reaction to take place;

iv) drying the probe;

v) subjecting the probe to mass spectrometry; and

vi) determining the activity of the enzyme, or the effect the test compound had on the activity of the enzyme, by detecting the presence and/ or absence of one or more products and/ or the one or more reactants.

2. A method as claimed in claim 1 wherein the mass spectrometry is a laser desorpton ionisation mass spectrometry, preferably a MALDI mass spectrometry.

3. A method as claimed in claim 1, 2 or 3 wherein the enzyme is a kinase, oxidoreductase, transferase, hydrolase, lyase, or ligase.

4. A method as claimed in claim 1 or 2 wherein the enzyme is a protein kinase, protease, carboxylase, esterase, phosphodiesterase, protein phosphatase, G-protein coupled receptor, ATP-dependent chaperone, cyclooxygenase, cytochrome P450, sialidase, short-chain dehydrogenase or short-chain reductase.

5. A method as claimed in claim 4 wherein the enzyme is a serine kinase, threonine kinase, tyrosine kinase, serine protease, cysteine protease, aspartyl protease, metalloproteinase or tyrosine phosphatase,

6. A method as claimed in any of the preceding claims wherein step ii) is essential, and the effect the test compound has on the enzymatic activity is determined by comparison to the results obtained in its absence.

7. A method as claimed in claim 6 which comprises adding the test compound pre, post or with the one or more reactants to determine its effect on enzyme activity.

8. A method as claimed in any of the preceding claims which is qualitive.

9. A method as claimed in any of claims 1 to 7 which is quantitive.

10. A method of determining the activity of a kinase or the effect a test compound has on the activity of a kinase by using mass spectrometry comprising:

i) providing a probe carrying an immobilised kinase;
ii) optionally introducing the test compound;
iii) introducing one or more reactants to the immobilised kinase for a time, and in a form sufficient for a reaction to take place;
iv) drying the probe;
v) subjecting the probe to mass spectrometry; and
vi) determining the activity of the kinase or the effect the test compound has on the activity of the kinase by detecting the presence and/ or absence of one or more products and /or the one or more reactants.

11. A method as claimed in claim 10 wherein the mass spectrometry is a laser desorpton ionisation mass spectrometry, preferably a MALDI mass spectrometry.

12. A method as claimed in any of claims 3 to 11 wherein the one or more reactants comprise a phosphate donor, a phosphate acceptor and a divalent cation.

13. A method as claimed in claim 12 wherein the phosphate donor is a phosphorylated substrate and the phosphate acceptor is a nucleotide di phosphate (NDP).

14. A method as claimed in claim 12 wherein the phosphate donor is a nucleotide tri phosphate (NTP) and the phosphate acceptor is a substrate to be phosphorylated.

15. A method as claimed in claim 12 wherein the divalent cation is magnesium or manganese.

16. A method as claimed in claim 13 or 14 wherein the nucleotide di phosphate or tri phosphate is an adenine di or tri phosphate (ADP or ATP).

17. A method as claimed in any of the preceding claims wherein the product is a nucleotide tri phosphate or a nucleotide di phosphate and its presence is detected.

18. A method as claimed in claim 17 wherein the nucleotide tri phosphate or nucleotide di phosphate are detected as $[NTP]^-$ or $[NDP]^-$ or as one or more adduct peaks thereof.

19. A method as claimed in claim 18 wherein the one or more adduct peaks are adduct peaks with a monovalent cat ion (M^+).

20. A method as claimed in claim 19 wherein the one or more adduct peaks include: $[ATP\ M]^-$, $[ATP\ M_2]^-$, and $[ATP\ M_3]^-$ and / or $[ADP\ M]^-$, $[ADP\ M_2]^-$, and $[ADP\ M_3]^-$.

21. A method as claimed in any of claims which further comprises, between step iv) and v), overlaying the probe with energy absorbing molecules.

22. A method as claimed in any of the preceding claims wherein the one or more reactants, and if present the test compound, are introduced to the immobilised enzyme in a compartmentalised form.

23 A method as claimed in claim 22 wherein the compartmentalised form is as a droplet.

24. A method as claimed in claim 23 wherein the droplet has a volume of less than 1 microlitre.

25. A method as claimed in any of the preceding claims wherein the one or more reactants are provided in a low salt buffer.

26. A method as claimed in claim 25 wherein the low salt buffer is an ammonium bicarbonate buffer.

27. A method as claimed in any of the preceding claims wherein the assay is conducted in a humid environment.

28. A method as claimed in any of the preceding claims wherein the one or more reactants and optionally any energy absorbing molecules are applied to the probe in register with the immobilised enzyme.

29. A probe for use with a mass spectrometer, comprising a support having an electroconductive target surface thereon characterised in that the target surface comprises an array having a plurality of enzymes immobilised thereon.

30. A probe as claimed in claim 29 wherein the enzymes are kinases, oxidoreductases, transferases, hydrolases, lyases, or ligases.

31. A probe as claimed in claim 29 or 30 wherein the enzymes are protein kinases, proteases, carboxylases, esterases, phosphodiesterases, protein phosphatases, G-protein coupled receptors, ATP-dependent chaperones, cyclooxygenases, cytochrome P450's, sialidases, short-chain dehydrogenases or short-chain reductases.

32. A probe as claimed in claim 31 wherein the enzyme is a serine kinase, threonine kinase, tyrosine kinase, serine protease, cysteine protease, aspartyl protease, metalloproteinase or tyrosine phosphatase,

33. A probe as claimed in any of claims 29 to 32 wherein the array is a micro array.

34. A probe as claimed in any of claims 29 to 33 wherein the enzyme is a fusion protein.

35. A probe as claimed in any of claims 29 to 34 wherein the enzyme is immobilised via a tag.

36. A probe as claimed in claim 35 wherein the tag is a biotin or a ble protein.